

# EVALUATION OF BLACKLINE TOLERANT ROOTSTOCKS - 2013

Janet Caprile and Chuck Leslie

## ABSTRACT

The purpose of these trials was to compare the performance of newly developed blackline tolerant rootstocks with Paradox and English rootstocks.

The Tennant trial was planted in April of 2005 as a randomized complete block design with 6 single tree replicates. Five rootstocks were field propagated to Vina in the fall and spring after planting. Any misses were re-budded or re-grafted up to 3 attempts. The WIP rootstocks were as readily field propagated as Paradox. Sunland was least readily propagated with only a 50% take.

Tree growth was similar among treatments at the beginning of the trial. Currently, the Paradox trees are the largest, WIP3 and WIP2 are intermediate, and OR Vina and Sunland are the smallest. Vigor followed a similar trend.

The trees began to bear in 2009. There have been no significant differences among yield ratings.

Salt damage was evident in some years. The Paradox rootstocks showed the least damage, the English rootstocks showed the most damage, and the WIP rootstocks were intermediate with WIP2 performing similar to Paradox in most years.

About 2/3 of the trees were damaged by the shaker in 2012 with WIP2 and seedling Paradox showing both a greater damage frequency and severity than trees on other rootstocks.

To date, half of the Sunland trees had been lost due to death or failure to propagate and one WIP2 tree had been lost to *Phytophthora* root rot. Half of the seedling Paradox trees had visible crown gall. Paradox rooted tree appear more susceptible walnut twig beetle (thousand canker disease) than WIP or English rootstocks and stress seems to predispose them to this damage.

The Maggiore trial was planted in the spring of 2011 as a randomized complete block design with the intention of mechanical harvesting the larger replicates. The scion variety was Chandler. The 3 main rootstock treatments had four 8 tree replicates of OR Chandler, WIP3, and seedling Paradox. A smaller number of trees were included of WIP2 (four 3 tree replicates) and WIP1 (seven single tree replicates) due to limited availability. Trees were of uniform 3/4" stock with no significant size differences among replicates at planting.

By the end of the 2<sup>nd</sup> growing season, the Paradox, WIP3 and own rooted were all similar in size with the WIP2 and WIP1 being slightly smaller. By the end of the third season, the own rooted Chandlers were slightly larger than WIP3 and Paradox and the trees on WIP1 and WIP2 were slightly smaller.

## OBJECTIVES

Compare the growth and performance of Walnut Improvement Program (WIP) blackline tolerant clonal rootstocks with Paradox and English rootstocks and own rooted trees.

## SIGNIFICANT FINDINGS

The WIP rootstocks are performing well compared to English and Paradox. WIP3 shows the most promise:

- Ease of propagation is much better than English and comparable to clonal Paradox
- Growth is better than English and WIP2 but slightly smaller than Paradox
- Yields are similar to all other rootstocks (by a rating system evaluation)
- No evidence of crown gall (50% of the seedling Paradox show crown gall)
- No loss to root disease (one WIP2 was lost to phytophthora)
- Slightly less sensitive to B and CI than English rootstock but slightly more sensitive than Paradox and WIP2.

Additional findings include:

- Leafing date is similar among all rootstocks
- Paradox is more susceptible to WTB attack than English or WIP rooted trees and stress may predispose Paradox to attack
- WIP2 and seedling Paradox were more susceptible to bark damage from harvest equipment.

## PROCEDURES

Tennant Trial: This trial was planted on open ground to the west of an existing established Vina orchard. The soil is a Brentwood clay loam transitioning to an Altamont clay with a calcareous shale/sandstone substratum at 48 inches just west of the trial area.

Trees were planted on April 15, 2005 in a randomized complete block design with six single tree replicates in a 25 foot offset square spacing. They are irrigated with hose pull sprinklers on the same schedule as the adjacent mature orchard. Treatments consist of own rooted (OR) Vina and field grafted Vina on five rootstocks: WIP2, WIP3, clonal Sunland, clonal Paradox (JX2), and seedling Paradox. Nineteen of the rootstocks were large enough to be fall budded to Vina on 9/13/05 by Alex Suchan. The remaining rootstocks and misses were spring grafted to Vina on 3/26/06 by a professional grafter from Burchell nursery. Six misses were re-budded on 8/27/06 and 2 misses were re-grafted on 3/12/07 by the same professional grafter. The OR Vinas were not grafted or budded.

Trunk circumference was measured at planting and annually at 30 cm above the ground.

The WIP yield rating of 1 to 9 (Table 3) was used to estimate yields annually beginning in 2009 with the first harvest.

A relative leaf burn rating of 1 (minor) to 5 (severe) was used to evaluate differences in salt burn symptoms among the rootstocks in 2009, 2010, 2012, and 2013. A composite leaf sample from

each treatment was collected on 9/14/10 and 7/10/12 to identify the elements that were causing the symptoms.

Many of the trees in the rootstock block had bark damage from the shaker in 2012 and the damage frequency and severity was measured in 2013. The occurrence of Crown Gall and Walnut Twig Beetle/Thousand Canker Disease (WTB/TCD) were also noted in 2013.

Maggiore Trial: This trial was planted as part of a new 35 acre OR Chandler orchard in April 2011 on a deep, uniform, Brentwood clay loam soil. Trees were planted in a randomized complete block design on an 18' by 24' spacing and irrigated with full coverage sprinklers. The treatments consist of:

1. Own-rooted Chandler (four 8 tree replicates)
2. Chandler on WIP3 (four 8 tree replicates)
3. Chandler on Paradox seedling (four 8 tree replicates)
4. Chandler on WIP2 (four 3 tree replicates)
5. Chandler on WIP1 (seven single tree replicates)

The first 3 treatments were designed to be large enough to mechanically harvest. Trunk circumferences were measured at planting and in the fall of 2012 and 2013. The block was also evaluated for the occurrence of Crown Gall and Walnut Twig Beetle/Thousand Canker Disease (WTB/TCD) in 2013.

## **RESULTS AND DISCUSSION**

Tennant Trial: There was some variability in the size of the stock at planting but size (measured as trunk circumference) had evened out by 2007 (the year after field budding and grafting) with no significant differences among the rootstocks. By 2009 differences in tree growth were becoming apparent (Table 1). The statistical differences vary slightly each year but generally the Paradox selections are the largest, the English selections are the smallest, and WIP2 and WIP3 are intermediate.

The ease and success of field propagation varied with rootstock (Table 2). WIP3 and clonal Paradox showed the best performance with 5 of the 6 trees (83%) taking after the first graft/ bud and the remaining tree taking with the 2<sup>nd</sup> try. Seedling Paradox had 4 of the 6 trees take on the first try, 1 tree take on the 2<sup>nd</sup> try and the last tree needing 3 tries to get a successful take. WIP2 had 3 of the 6 trees take on the first try, 2 of the 3 remaining trees take on the 2<sup>nd</sup> try and the last tree take on the 3<sup>rd</sup> try. Sunland had only 3 trees take the first time, 1 tree died and 2 remaining trees never took after 3 attempts. The quality of the bud/graft wood was good and the grafters were professional so the variation in take likely represents the relative ease of propagation among the rootstocks on a slightly challenging site. The soil is slightly shallower than is ideal and the trees were irrigated on the mature orchard schedule.

Trees began to bear in 2009 and annual yield estimates were collected using the Walnut Improvement Program rating scale (Table 3). There were no statistical differences in the estimated yields.

Salt burn on leaves was evident by harvest in 2009, to a lesser extent in 2010, not at all in 2011, and a minor amount in 2012 and 2013. The difference in severity between the rootstocks as indicated by a visual rating of symptoms is presented in Table 4. Statistical significance varies among years but generally the Paradox rootstocks had less severe symptoms, the English had the most severe, and the WIP rootstocks were intermediate with WIP2 consistently exhibiting less severe symptoms than WIP3, and being similar to Paradox. Leaf samples taken in September 2010 and July of 2012 are included in the previous year's report. They showed high levels of chloride and boron in all treatments with differences in rootstock uptake generally reflecting field symptomology.

The frequency and severity of bark damage due to harvesting equipment is included in Table 5. Most rootstocks had about 2/3 of the trees showing some damage and of those, about 20% of the circumference was affected. However, trees on WIP2 and seedling Paradox rootstocks had significantly more bark damage both in terms of frequency (83-100% of trees damaged, respectively) and severity (an average of 57-56% of the circumference damaged, respectively) than on other rootstocks.

To date, half of Sunland trees have been lost due death or failure to propagate. One WIP2 tree had been lost to phytophthora root rot. Half of the seedling Paradox trees have visible crown gall while none of the other (clonal) rootstocks do. The same seedling Paradox trees with crown gall and the clonal Paradox with significant bark damage (20-50% circumference damaged) also show evidence of a moderate (10-100 strikes/tree) Walnut Twig Beetle/Thousand Canker Disease (WTB/TCD) on the rootstock portion. None of the other trees show any evidence of WTB/TCD. This would indicate that Paradox is more susceptible than English or WIP rooted trees and that tree stress may predispose those Paradox to attack.

Maggiore Trial: Trees were of fairly uniform 3/4" stock with no significant differences in tree diameters among treatments at planting. By the fall of 2012, Paradox, WIP3, and own rooted Chandlers were comparable in size and larger than the WIP2 and WIP1 rootstocks (Table 5). By the fall of 2013, the own rooted Chandlers were slightly but significantly larger than those on WIP3 and Paradox rootstocks. Trees on WIP1 and WIP2 rootstocks were still the smallest.

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Table 1: Tennant Trial: Average growth as measured by trunk circumference at 30 cm.

Rootstock	Trunk Circumference (cm)						
	4/05	1/07	10/09	9/10	9/11	11/12	10/13
OR Vina - cl	5.8 a	10.5	35.3 b	39.6 a	47.2 a	51.3 a	53.6 a
Sunland – cl	7.6 bc	10.9	20.6 a	36.5 a	42.0 a	45.3 a	48.3 a
WIP2 – cl	7.2 b	11.6	32.8 ab	38.2 a	48.1 ab	53.6 a	57.1 a
WIP3 -cl	8.4 c	12.3	37.1 b	43.2 ab	51.7 ab	57.5 a	61.1 ab
Paradox -cl	8.0 bc	12.7	50.0 c	56.0 c	65.8 c	72.2 b	75.8 c
Paradox - sd	7.3 b	13.1	42.7 bc	52.4 bc	60.3 b	68.8 b	71.3 bc
		N.S.					

Means followed by the same letter are not significantly different at P<0.05 using Fishers LSD

N.S. indicates no significant difference at P<0.05 using Fishers LSD

Table 2: Success rate of field grafting and budding of five rootstocks

<i>Rootstock</i>	<i>Took 1st try</i>		<i>Took 2nd try</i>		<i>Took 3rd try</i>		<i>Final Take</i>	
	<i>Tree no.</i>	<i>%</i>	<i>Tree no.</i>	<i>%</i>	<i>Tree no.</i>	<i>%</i>	<i>Tree no.</i>	<i>%</i>
Sunland – cl	3/6	50%	0/2	50%	0/1	0%	3/6*	66%
WIP2 – cl	3/6	50%	2/3	66%	1/1	100%	6/6	100%
WIP3 -cl	5/6	83%	1/1	100%			6/6	100%
Paradox -cl	5/6	83%	1/1	100%			6/6	100%
Paradox - sd	4/6	67%	1/2	50%	1/1	100%	6/6	100%

\* 1 tree died the summer after the first spring grafting, 2 trees never took

Table 3: Average yield 2009-2013

<i>Rootstocks</i>	<i>Yield Rating</i>					<i>Yield Rating System</i>
	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	
OR Vina - cl	3.3	5.3	6.0	6.7	6.6	1 = 1-2 nuts 2 = 3-10 nuts 3 = Look close to see nuts 4 = Low yield – easy to see nuts 5 = Low commercial yield 6 = Acceptable commercial yield 7 = Good commercial yield 8 = Great commercial yield 9 = More nuts than leaves
Sunland – cl	3.5	5.7	6.2	6.8	6.8	
WIP2 – cl	3.5	5.5	5.0	6.2	6.3	
WIP3 -cl	3.3	5.7	6.1	6.5	6.6	
Paradox -cl	3.5	5.8	6.2	6.7	6.8	
Paradox - sd	3.3	5.2	5.1	6.3	6.6	
	N.S.	N.S.	N.S.	N.S.	N.S.	

N.S. indicates no significant difference at P<0.05 using Fishers LSD

Table 4: Average rating for salt burn symptoms on leaves.

<i>Rootstocks</i>	<i>Leaf symptom Rating<sup>1</sup></i>							
	<b>2009</b>		<b>2010</b>		<b>2012</b>		<b>2013</b>	
OR Vina - cl	3.5	Cd	2.2	b	1.6	c	2.8	bc
Sunland – cl	4.0	D	2.4	b	1.7	c	3.2	c
WIP2 – cl	2.8	Bc	1.6	a	1.0	a	2.6	ab
WIP3 -cl	3.3	Cd	2.0	ab	1.4	bc	2.8	bc
Paradox -cl	1.8	A	2.0	ab	1.0	a	2.5	ab
Paradox - sd	2.2	Ab	2.0	ab	1.1	ab	2.4	a
Fischer LSD P<	0.04		0.08		.003		0.04	

<sup>1</sup> Leaf burn symptom rating:  
 1 = little (minor tip burn)  
 3 = moderate (thin marginal burn)  
 5 = severe (thick marginal burn and interveinal chlorosis)

Table 5: The amount of bark damage due to shaker operations during the 2012 harvest.

<b>ROOTSTOCKS</b>	<b>FREQUENCY</b>	<b>RANGE</b>	<b>SEVERITY</b>	
	No. of trees with damage	% damaged circumference by tree	Avg. % damaged circumference	
OR Vina - cl	4/6	0, 0, 10, 20, 25, 30	21.2	a
Sunland – cl	2/3	0, 20, 20	20.0	ab
WIP2 – cl	4/5	0, 30, 50, 75, 75	57.5	bc
WIP3 -cl	4/6	0, 0, 5, 10, 30, 30	18.75	a
Paradox -cl	4/6	0, 0, 5, 20, 30, 50	26.25	a
Paradox - sd	6/6	30, 50, 60, 60, 70	55.8	c
Fischer LSD P<			0.002	

Means followed by the same letter are not significantly different at P<0.05 using Fishers LSD

Table 6: Maggiore Trial – trunk diameter (cm) at 50 cm (20 inches) above the ground

<i>Rootstocks</i>	<i>Spring 2011</i>	<i>Fall 2012</i>	<i>Fall 2013</i>
Paradox	2.0 a	6.6 a	10.8 a
WIP3	2.1 a	6.8 a	10.9 a
Own rooted	2.0 a	6.9 a	11.7 b
WIP2	2.3	5.7	9.3
WIP1	2.1	5.9	9.9

Means followed by the same letter are not significantly different at P<0.05 using Fishers LSD